Remarks

Claims 1 and 11-26 are pending. Claims 1 and 19 have been amended. Support can be found in the specification for example at page 5, lines 17-34. Applicants believe that it is proper for the present amendment to be entered since it places the application in condition for allowance. Alternatively, entry of this amendment is proper since it places the claims in better form for appeal, does not raise any new issues, and does not require further consideration or search.

Rejection Under 35 U.S.C. § 103

Claims 1 and 11-26 were rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 5,451,456 to Marchessault *et al.* ("Marchessault") or the published PCT application, PCT WO 91/13207. The Examiner further rejected claims 1 and 11-26 as obvious under 35 U.S.C. § 103(a) over Marchessault in view of U.S. Patent No. 4,016,306 to Miyagawa *et al.* ("Miyagawa"). The applicant respectfully traverses these rejections.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both

The Claimed Invention

The claims define an aqueous, film-forming composition comprising:

(1) a polyhydroxyalkanoate copolymer polyester

(2) wherein the composition forms a water-resistant non-crystalline film at ambient temperatures and

(3) at least 60% of polyester particles have a density of less than 102% Dmin, Dmin being the lowest density attainable by the polyester.

Marchessault

Marchessault describes latex films formed from polyhydroxyalkanoate compositions comprising 0-100%, preferably 65-100% and more preferably 70-100% by weight of 3-hydroxybutyrate (3HB) and 100-0%, preferably 35-0% and more preferably 30-0% by weight of 3-hydroxyvalerate (3HV). A preferred copolymer is 79% 3HB/21% 3HV (column 4, lines 5-29). The latex may also contain synthetic latex polymers and copolymers such as styrenebutadiene, and water soluble polymers such as carboxymethylcellulose and starch. These polymers and copolymers may comprise up to 10 parts by weight of the solids (column 7, lines 13-18).

Films are made from these compositions by casting a dilute solution of 15-20% w/w solids on an impervious surface and allowing the water to evaporate slowly at room temperature. **However, the air-dried films must be heated in a drying oven at a temperature of 30 degrees below T_m to cause even moderate fusion** (column 7, lines 23-25). Air dried or

partially fused films are hot pressed at 100-140°C and 1000-5000 psi to produce flexible and translucent films of **average to high crystallinity** (column 7, lines 29-32).

Accordingly, Marchessault does not disclose an **aqueous** solution of PHA copolymer that forms a water-resistant **non-crystalline** film at ambient temperatures.

Dense, transparent films are also formed by exposing air dried films to solvent or liquid vapor atmospheres, such as chloroform and other halogenated solvents, ethylene or propylene carbonate, acetic anhydride, dimethylformamide, ethylacetoacetate, triolein, acetic acid and alcohols (column 7, lines 38-45). Crystallinity is not provided. These films also do not anticipate the claimed composition because they are not aqueous PHA copolymer compositions.

The Examiner's position is that a formulation, as described by Marchessault, comprising 100% PHB/PHV or at least 90% PHB/PHV latex and up to 10% synthetic latex copolymers would form a water-resistant non-crystalline film at ambient temperature since a higher concentration of PHB would yield tighter interactions and/or physical crosslinks between polymer molecules. This assertion directly contradicts the results shown by Marchessault. In Example 1, a few grams of 21% HV polymer latex was diluted to 20-30% w/w solids with distilled water. The resulting mixture was poured on a clean glass surface and allowed to air dry overnight at room temperature. A film with little or no strength was obtained. This is evidence that the compositions disclosed by Marchessault do not contain particles wherein 60% of have a density less than 102% D_{min} and thus cannot form a water-resistant film at ambient temperature.

Marchessault describes virgin wet granules of the polymer or copolymer that are produced by fermentation and which have never been subject to drying as being essentially non-crystalline (column 3, lines 55-60). Marchessault states that x-ray diffraction patterns reveal that the colloidal particles after drying are of good crystallinity (column 6, lines 45-50).

Therefore, Marchessault teaches away from a non-crystalline film formed at ambient temperature.

Marchessault does not state that 60% of the polymer particles must have a density less than 102% D_{min}. Marchessault does not disclose any relationship between the density of the polymer particles and the ability to form a water-resistant film at ambient temperature.

It is well known that the degree of crystallinity changes under different preparation conditions (See e.g. Bauer et al., *Colloid and Polymer Science*, 266, 241, 1988; Marchessault, et al., *Novel Biodegradable Microbial Polymers*, 97-112, Klower Academic Publishers, 1990) and that density measurement gives a simple indication of the degree of crystallinity.

D_{min} is defined as the theoretical minimum density possible for a polyester and therefore corresponds to absolute total non-crystallinity. The claims in this application require at least 60% of the particles have a density less than 102% D_{min} in order to form coatings on surfaces at ambient temperature which on drying have improved early hardness and tack resistance. The presence of ultra highly non-crystalline polyester particles appears to lead to the formation of numerous crystalline zones or "crystallites" in which adjacent polyester chains are held together

by lateral attractions which act like chemical crosslinks. Lateral attractions are well known in other crystalline polymers such as isotactic polypropylenes. Lateral attractions are quasi-crosslinks, that is, they are a physical rather than chemical phenomena. The formation of these quasi-crosslinks can occur quickly and the consequent hardening and increase in tack resistance are likewise quite rapid.

The polymer compositions disclosed by Marchessault cannot form a water resistant film at ambient temperature (Example 1). On the contrary, temperatures as high as 140°C and pressures as high as 5000 psi or the use of organic solvents must be employed in order to chemically cross-link the polymer particles.

The Examiner has consistently maintained that the applicants have not described a different or unique process that allows one of ordinary skill in the art to obtain polymer particles in which 60% have a density that is less that 102% of D_{min} and therefore the particles of Marchessault must be able to form a film at ambient temperature since they are harvested in a manner analogous to the method described in the present application. Such an assertion fails to grasp the crux of the applicant's invention. The examiner's attention is drawn to page 4, lines 18-26. This references an earlier filed application which does describe such a process. While the reference application does not state that the resulting particles are PHA particles having the claimed ratio of low density particles, such a statement is unnecessary. This is part of applicants' discovery! Applicant's discovery includes that this process yields a high percentage of low

density, non-crystalline particles that could be used to form a non-crystalline film using an aqueous suspension at ambient temperature which is the subject of the claims in the present application.

The claims have been amended to clarify the claimed composition as one containing PHA polymer particles wherein at least 60% of the polymer particles have a density less than 102% of D_{min}, which can *then* be used to form a water-resistant non-crystalline film at ambient temperatures. It is believed that the amendments to the claims do not change the claim scope, but clarify that it is because applicants have discovered that there are differences in PHA particles that can be used advantageously to form a film at ambient temperature.

The claims now clearly require one of ordinary skill in the art to select particles with the correct density in order to prepare a film at ambient temperature that is water resistant.

Marchessault does not disclose that the ability to form a water resistant film at ambient temperature is dependent on the densities of the polymer particles. Therefore, one of the ordinary skill in the art would not be motivated to prepare a polymer composition wherein at least 60% of the polymer particles have a density less than 102% D_{min}.

Miyagawa

Miyagawa discloses an acrylic resin composition containing a thermoplastic acrylic polymer in combination with a specific ethylenically unsaturated diacrylate that is cured by irradiation in an aqueous medium in the presence of a photosensitizer to form a cured film

(abstract). Miyagawa states that such films are cured by radiation-induced cross-linking (column 1, lines 50-51).

Marchessault does not disclose that 60% of the polymer particles must have a density less than 102% D_{min} in order to form water-resistant films at ambient temperature. The use of traditional synthetic film-forming polymers such as the acrylic resins described by Miyagawa would not affect the ability of the polymer compositions of Marchessault to form water-resistant films at ambient temperature since the polymer particles described by Marchessault do not have the necessary densities. One of ordinary skill in the art would not be motivated to combine the teachings of Marchessault and Miyagawa to prepare a polyhydroxyalkanoate polymer film at ambient temperature.

Furthermore, the crosslinking of polymer chains as described by Miyagawa is a chemical phenomenon. Miyagawa discloses the use of ethylenically unsaturated diacrylates. Such compounds contain pi bonds which upon irradiation react to form covalent bonds to adjacent polymer chains. In other words, the process described by Miyagawa involves simultaneously polymerizing the monomer and forming the film in an aqueous medium.

Polyhydroxyalkanoates do not contain carbon-carbon double bonds. Further, the polymer is prepared prior to application of the polymer composition to a surface. Upon drying, crystallites form in the polymer film, which result in the formation of lateral attractions, which

are physical not chemical cross links. Irradiation of the polymer particles is not necessary to form a water-resistant film at ambient temperature.

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AMENDMENT AND RESPONSE TO OFFICE ACTION

Allowance of claims 1 and 11-26 as amended is respectfully solicited.

Respectfully submitted,

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Certificate of Facsimile Transmission

I hereby certify that this Amendment and Response to Office Action, and any documents referred to as attached therein, are being facsimile transmitted on **June 8, 2004** to the Commissioner for Patents, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450.

Ronna Berman

Date June 8, 2004
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